FRONT: Front-Resolving Observational Network with Telemetry

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LONG-TERM GOALS

The goal of this National Ocean Partnership Program is to develop an autonomous network of ocean sensors that telemeter their physical and biological data to shore in real-time with cutting edge communication technologies. With additional remotely sensed data (satellite measurements of temperature and color and shore-based high-frequency radar (CODAR) measurements of surface currents), these data streams will be assimilated into physical and biological models to predict the 4-dimensional properties of a limited coastal region. The accuracy of the assimilated products will be tested with data from a series of high-resolution ship surveys. Additional measurements of turbulence and other small-scale properties will be used to aid the eddy diffusivity parameterizations used in the data assimilation model.

OBJECTIVES

The objectives of the URI component of the FRONT project is to produce maps of SeaWiFS-derived phytoplankton chlorophyll distributions, sea-surface temperature (SST) and surface currents for the data assimilation model. The URI group will also undertake regional surveys of the hydrographic fields at several times during the project.

In addition to these data products, we will examine the variability of SeaWiFS-derived phytoplankton chlorophyll distributions and its coupling to physical processes in the FRONT region. We will compare pigment fronts with thermal fronts and other collected in situ data sets to examine the biophysical coupling. We will attempt to understand the mechanism(s) of formation and the dynamical significance of mid-shelf SST fronts. The turbulence (microstructure) measurements will be used to examine the best way to parameterize the mixing processes for the modelling work. Also, we will develop improved methods of obtaining surface currents from the CODAR radar backscatter measurements.

APPROACH

Using SeaWiFS ocean color images, maps of phytoplankton pigment (chlorophyll) in and near our study site will be produced. These images have been processed using NASA's software processing package, SeaDAS. Thermal images covering the same time-period and the same study area are available from the URI Satellite Archive. The annual cycles of chlorophyll and sea-surface temperature patterns and their distributions will be used to study the variability and co-variability between chlorophyll, sea surface temperature and other collected data sets as part of this project.

CODAR stations will be established to measure surface currents in a region where SST fronts occur. We will analyze concurrent AVHRR SST images for the occurrence of fronts within the range of CODAR. The CODAR-derived velocities will be combined with SST to estimate the rate of change of horizontal SST gradients (frontogenic tendency) due to the action of the horizontal deformation field.

Microstructure measurements using the MicroSoar (Dillon et al. 1999) on a towed body will be compared to microstructure measurements from an AUV operated by Dr. Edward Levine (NUWC). Estimates of mixing rates will be investigated in context of the larger hydrographic fields, especially in the vicinity of the fronts.

Improvements to the determination of surface currents using the CODAR data will be investigated by the use of global smoothness constraints to remove the present ambiguity inherent in the currently used CODAR algorithm.

WORK COMPLETED

We have surveyed the three proposed sites for CODAR stations (which have been ordered) to determine the optimum location for the antennas.

We have just begun work on assembling a time-series of relatively cloud-free pigment (SeaWiFS) and thermal (AVHRR) images for our study site for the 1998 period. This is the first full year where both ocean color and sea-surface temperature data are available. Both image data sets have been processed and remapped to the same projection thereby allowing easy, side-by-side, comparison. To ensure a high-quality line-up of the coastline each image is also visually examined and, if necessary, manually remapped to produce the best fit. This step alone is very time-intensive and can take several minutes per image. Subsequently, images are run through the declouding routines to flag any clouds present in the image. Finally, the frontal edge-detection algorithm will be run and an annual cycle of pigment and thermal fronts will be produced.

Pre-cruise preparations for the regional hydrographic surveys and microstructure studies is underway.

RESULTS

Since this project has just started (August 1999), no significant results are available at this time.

IMPACT/APPLICATIONS

A full year of contemporaneous pigment and thermal data will provide details on the annual cycle of each as well as their variability and co-variability. The same also holds true for the pigment and thermal front activity over the same time period. Furthermore, information on the concurrent pigment and thermal patterns may be important for partners involved in the model initialization aspect, planning for the survey cruises, or deployment of moorings, arrays etc.

Improvements to the CODAR retrieval algorithm have the potential to increase the accuracy and spatial resolution of surface current maps derived from CODAR measurements.

The eddy parameterizations based on the coastal microstructure measurements will be available for testing in dynamical models of the coastal ocean.

RELATED PROJECTS

This is a cooperative project with many other institutions. Additional reports by Bodgen (UCONN), Levine (NUWC) and Rice (SSC-SD) with the same title describe our other partners' work.

REFERENCES

Dillon, T., J.A. Barth, A. Erofeev and G. May. 1999: MicroSoar: A new instrument for measuring microscale turbulence from rapidly moving submerged platforms, *J. Atmos. Ocean. Techn.* (submitted)